Monitoring Urban Streams: Strategies and Protocols

Governmental mandates and public awareness have forced progressively smaller agencies and organizations to initiate stream monitoring programs, particularly in urban and urbanizing areas. Many of these monitoring efforts lack either a coherent conceptual framework or appropriately chosen methods and, as such, do not produce adequate information to reach their intended goals, such as improving acquatic system quality or health. Monitoring techniques developed in research settings or by large federal agencies are not feasible for the vast majority of municipalities that are now initiating these programs. The University of Washington's Center for Streamside Studies developed strategies and protocols related to identifying management questions and determining levels of monitoring, parameters to measure, and methods of measurement.

The most common problem encountered in stream monitoring is not with executing specific monitoring protocols. Many documents exist that specify proper techniques for data collection. Instead, the major shortcoming is in choosing an *approach* that will both provide sufficient data to answer particular management questions and that is feasible for the institutional context and available resources. Such an approach does not lead to the same monitoring program for every stream in every institutional setting; rather it provides the basis for crafting the most appropriate monitoring program across a variety of settings.

Thornton Creek, Seattle

Monitoring Strategy

A sound monitoring strategy must:

- Identify the management question(s) being addressed
- Determine the institutional level of effort required (and available) to make particular kinds of measurements effectively
- Identify specific parameters that should and can be measured

Management Questions

Three common questions used to characterize the health of streams in urbanizing watersheds are:

1. Is the stream in good condition?
2. Are there trends in stream condition?
3. How should planned stream restoration or rehabilitation efforts be prioritized?

The first question (and commonly the third) carries an implicit or explicit comparison to some reference condition that is presumed to be "good." Measurements must be accurate and transferable from one stream to another, and the chosen reference should be truly applicable. Therefore, some method of stream stratification or classification is required in order to select appropriate comparisons from the tremendous variety of natural stream types.

Although related, these questions require different types of measurements at different levels of detail and precision. The second question is the simplest to answer. It requires only a set of measurements capable of showing a response to watershed changes, repeated at the same location over time. The measurements need not be transferable, only reproducible.

The third question leads to additional questions (How bad are conditions now? How good might they become? What elements of a healthy stream are most degraded? Can they be repaired?) and demands the most comprehensive view of the channel because streams can be degraded in many different ways.

Levels of Monitoring

Many monitoring programs use unrealistically complex protocols for the type of staff or volunteers available. To provide a basis for comparison, the following assumed scale of institutional "levels of effort" are used:

Level 1 is rapid, low cost, but likely to generate only qualitative or imprecise quantitative data. These measures are single snapshot evaluations and typically have modest utility because they can reliably offer only a coarse discrimination of aquatic-system quality or health. However, they may be useful in evaluating gross conditions ("good" vs. "bad") and are suitable for a wide range of volunteers with only minimal training.

Level 2 requires nominal equipment, is relatively rapid, and likely to generate reproducible (although coarse) quantitative results. These techniques require trained volunteers or professionals. Measures can be useful to classify a stream or reach, or to characterize conditions relative to some reference condition. As such, they can be used for both one-time and continuous monitoring programs, but most parameters will undergo substantial change before any difference is detected.

Parameters to Measure

Effective monitoring requires knowledge of *what* to measure. This analysis addresses selected *physical* elements of the stream system. Biological measurements can also be valuable.

There is little evidence that additional tasks executed at Level 1 will produce any useable results for guiding management decisions. With these measurements, a coarse discrimination of stream quality is possible, and the worst channels will be apparent. Detecting change over time, however, will be highly insensitive; damage will occur long before these methods can unequivocally identify it.

Level 2 measurements are useful because 1) they provide a more detailed and precise evaluation of stream quality than Level 1 measurements, 2) they offer the chance to detect modest changes in channel conditions over time, 3) they identify credible reference conditions, and 4) they generate some of the information needed to design a rehabilitation project.

Parameters and Methods of Measurement

LEVEL 1

Shade/canopy Gridded mirror (densiometer) used to measure the percent shade, or visual estimate of canopy cover

Bank erosion and hardening Verbal rankings for magnitude of bank erosion, located by reach

Large Woody Debris Count the number of pieces in the channel [minimum length > 3 m (10') and minimum diameter > 25 cm (10")]. Include four numerical zones used to identify the location within the stream channel *or* limit count to those pieces within bankfull channel.

LEVEL 2 (includes Level 1 parameters)

Gradient Several alternative methods are available, with the use of hand-held equipment generally adequate.

Substrate composition "Point and count" method with 100 randomly selected grains from upstream side of point bar or channel-spanning riffle

Pools Count and measure the number of pools in a specified length or reach of stream, using residual depth and wetted channel width to define minimum size (specify minimum depth for inclusion)

Example References

Platts, W.S., Megahan, W.F., and Minshall, G.W.: 1983, *Methods for evaluating stream, riparian, and biotic conditions*, General Technical Report INT-138, U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Poole, G.C., Frissell, C.A., and Ralph, S.C.: 1997, Instream habitat unit classification: inadequacies for monitoring and some consequences for management, *Journal of the American Water Resources Association*, 33(4), 879-896.

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